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ABSTRACT

Air Force Officer Qualifying Test (AFOQT) Form M was constructed as a replacement for AFOQT Form L in Fiscal Year 1974. The new form serves the same purposes as its predecessor and possesses basically the same characteristics. It yields Pilot, Navigator-Technical, Officer Quality, Verbal, and Quantitative composite scores. Three sets of conversion tables are provided for examinees at the various educational levels where the test is adminstered. Standardization was accomplished by equipercentile conversion to composites of Project TALENT tests from a previous form which was adminstered to Air Force Academy candidates, and thence to the new form in a stratified sample of basic airmen. This strategy permits the new AFOQT scores to be related to Academy candidates and to 12th grade males in the original Project TALENT study. Because recent operational data suggest that the AFOQT is becoming too difficult, a correction which was used prior to AFOQT-64 was reinstated. The correction is for the unusually high academic aptitude of the Academy candidate group, especially with respect to the quantitative domain. The correction primarily affects the Navigator-Technical, Officer Quality, and Quantitative composites and should lead to somewhat increased qualification rates without fundamentally changing the AFOQT normative base. (Author)

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DEVELOPMENT AND STANDARDIZATION OF THE AIR FORCE OFFICER QUALIFYING TEST FORM M

By

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March 1974

Final Report for Period March 1972 – March 1974

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AIR FORCE SYSTEMS COMMAND
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Air Force Officer Qualifying Test Form M was constructed as a replacement for AFOQT Form L in Fiscal Year 1974. The new form serves the same purposes as its predecessor and possesses basically the same characteristics. It yields Pilot, Navigator-Technical, Officer Quality, Verbal, and Quantitative composite scores. Three sets of conversion tables are provided for examinees at the various educational levels where the test is administered. Standardization was accomplished by equipercentile conversion to composites of Project TALENT tests from a previous form which was administered to Air Force Academy candidates, and thence to the new form in a stratified sample of basic airmen. This strategy permits the new AFOQT scores to be related to Academy candidates and to 12th grade males in the original Project TALENT study. Because recent operational data suggest that the AFOQT is

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PREFACE

Replacement forms of the Air Force Officer Qualifying Test are produced on a biennial cycle. A new form of this test was produced in Fiscal Year 1974 under Project 7719, Air Force Personnel System Development on Selection, Assignment, Evaluation, Quality Control, Retention, Promotion, and Utilization; Task 771912, Selection and Classification Instruments for Officer Personnel Programs.

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DEVELOPMENT AND STANDARDIZATION OF THE AIR FORCE OFFICER QUALIFYING TEST FORM M

I. INTRODUCTION

In 1953, a selected group of paper-and-pencil subtests from the World War II aircrew classification batteries were combined with an academic aptitude test called the Aviation Cadet-Officer Candidate Qualifying Test. The result was a new operational instrument known as the Air Force Officer Qualifying Test (AFOQT). This test has remained the backbone of the Air Force officer selection and classification testing program down to the present. During its twenty years of use, thirteen different forms of the test were constructed, and from time to time other tests were derived from it to meet special needs. The entire history of this effort has been documented (Valentine & Creager, 1961; Miller & Valentine, 1964; Miller, 1966; Miller, 1968; Miller, 1970; Miller, 1972). Extensive technical data pertaining to the AFOQT have been summarized in a report on interpretation and use of AFOQT scores (Miller, 1969).

The AFOQT is used to select candidates for most programs leading to a commission, with the Air Force Academy the only major exception. It is also used to select candidates for undergraduate pilot and navigator training, and to assist in assigning nonflying officers entering their initial tour of active duty. Under current production schedules, each form of the AFOQT serves these functions for the Air Force throughout a two-year cycle and is then retired. In accordance with this cycle, AFOQT Form M was scheduled for introduction in the AFROTC commissioning program on 1 September 1973, approximately coinciding with the beginning of a new academic year, and in all other programs on 1 January 1974.

II. GENERAL CHARACTERISTICS

AFOQT Form M was constructed according to the same plan as all its recent predecessors. It consists of 522 test items organized into thirteen subtests from which five composite scores are obtained. These are the Pilot, Navigator-Technical, Officer Quality, Verbal, and Quantitative composites. Only these composites are used in ways which affect the composition of the Air Force and the careers of individuals. Scoring by subtests is done for research. The composition of the test is shown in Table 1.

Table 1. **Content and Organization of AFOQT Form M[a]**

Booklet and Subtest	No. of Items	Composites				
		Pilot	Navigator-Technical	Officer Quality	Verbal	Quantitative
Booklet 1 (AFPT 972)						
Quantitative Aptitude	60		X	X		X
Booklet 2 (AFPT 973)						
Verbal Aptitude	60			X	X	
Officer Biographical Inventory[b]	96			X		
Booklet 3 (AFPT 974)						
Scale Reading[c]	48		X			
Aerial Landmarks[c]	40		X			
General Science	24		X			
Booklet 4 (AFPT 975)						
Mechanical Information	24	X	X			
Mechanical Principles	24	X	X			
Booklet 5 (AFPT 976)						
Pilot Biographical Inventory	50	X				
Aviation Information	24	X				
Visualization of Maneuvers[c]	24	X				
Instrument Comprehension[c]	24	X				
Stick and Rudder Orientation[c]	24	X				
Total	522					

[a]Associated administrative and scoring manuals are AFPT 970 and 971, respectively. Associated answer sheets are AFPT 967 and 968. Special manuals and answer forms are used in the AFROTC program. Scale Reading and Aerial Landmarks are scored R-W/4; Visualization of Maneuvers and Instrument Comprehension are scored R - W/3. Other subtests are scored rights only.

[b]Not administered to female applicants.

[c]Speeded subtests.

Form M is published in five test booklets which are accompanied by administrative, scoring, and interpretive manuals, a set of six hand scoring keys, and two special Digitek answer sheets. The answer sheets and interpretive manual are unchanged from the preceding form. The scoring manual contains three sets of tables for converting raw scores to percentiles. Selection of the proper set of tables is done on the basis of the educational level of the examinee. The educational level in the various programs where the test is used can vary from college freshman to college graduate. The use of separate conversion tables for different levels is supported by two studies (Gregg, 1968; Tupes & Miller, 1969) which provide quantitative evaluation of the elevating effect of education on AFOQT scores.

III. ITEM SELECTION

Each form of the AFOQT is calculated to have the same difficulty as the preceding form. The selection of items is guided by the principle that the item of median difficulty in each subtest should be answered correctly by 50 percent of the examinees for whom the test is appropriate, with the other items in the subtest having a considerable range of difficulty about the median. The only exceptions are the two biographical subtests, for which the concept of difficulty has a somewhat different meaning. Biographical items in a sense have no right or wrong answers, but responses are considered right or wrong according to whether they do or do not conform to the scoring key.

The median difficulty and range of difficulty of items in Form M, except the biographical items, are shown in Table 2. Difficulties in the table are expressed as percentages of examinees who answer the items correctly. Thus, the higher values represent the easier items. The desired median difficulty is closely approximated in each subtest, but the range of difficulty is somewhat narrow in the spatial subtests. A narrow range for spatial items has characterized previous forms of the AFOQT.

Table 2. **Item Difficulty Levels and Internal Consistency of AFOQT Form M[a]**

Subtest	Difficulty Level		Internal Consistency	
	Range	Median	Range	Median
Quantitative Aptitude	.12-.87	.52	.21-.85	.50
Verbal Aptitude	.14-.85	.54	.26-.84	.46
Scale Reading	.20-.81	.57	.17-.77	.44
Aerial Landmarks	.26-.82	.52	.27-.81	.53
General Science	.13-.92	.52	.12-.78	.38
Mechanical Information	.18-.89	.50	.28-.79	.53
Mechanical Principles	.22-.89	.54	.10-.60	.37
Aviation Information	.27-.82	.52	.24-.66	.42
Visualization of Maneuvers	.28-.85	.69	.24-.68	.38
Instrument Comprehension	.32-.85	.62	.27-.69	.46
Stick and Rudder Orientation	.51-.84	.72	.24-.66	.51

[a]Based on samples of 400 or more student officers.

Table 2 also presents internal consistency data for Form M. Internal consistency refers to the correlation between the correct response to an item and the total score of the subtest of which the item is a part. Again the biographical subtests are a special case. Low internal consistency is to be expected of them. In other subtests it is desired that the internal consistency be high, but it is not possible to have uniformly high internal consistency in items having the desired distribution of difficulty. The range and median of the internal consistency distributions for Form M are similar to those for other forms of the AFOQT. No items having positive internal consistency coefficients for any incorrect response were included in the test. Some anchor items which appeared in previous forms were included.

IV. RELIABILITY, INTERCORRELATIONS, AND VALIDITY

Though various forms of the AFOQT are used consecutively, they have in effect the properties of alternate forms. It is therefore assumed initially that such technical data as reliability, validity, and intercorrelations of composites for a new form are similar to the corresponding data for preceding forms. This assumption can not be tested adequately in the standardization sample because the strategy does not require that this sample be representative of the population on which the test is to be used. Moreover, validity studies usually include data from more than one form.

Reliability and intercorrelation data for the composites are presented in Tables 3 and 4. These are based on previous forms but are considered to be estimates for Form M. The reliability data are determined from the formula for the reliability of a composite (Wherry & Gaylord, 1943), which in turn is based on test-retest or Kuder-Richardson Formula 20 data for the subtests. The biographical subtests are omitted.

Table 3. **Estimated Reliability of Composites, AFOQT Form M**

Composite	Reliability
Pilot	.91
Navigator-Technical	.95
Officer Quality	.94
Verbal	.89
Quantitative	.93

Table 4. **Estimated Intercorrelation of Composites, AFOQT Form M**

Composite	Pilot	Navigator-Technical	Officer Quality	Verbal
Navigatory-Technical	.70			
Officer Quality	.50	.79		
Verbal	.43	.57	.80	
Quantitative	.50	.87	.85	.55

A convenient summary of validity data is contained in the AFOQT Manual for Interpretation, AFPT 901, and in the technical report on interpretation and use of AFOQT scores (Miller, 1969). The most recent validities for performance in flying training are to be found in the development report for Form L (Miller, 1972).

V. STANDARDIZATION

The AFOQT has traditionally been standardized on an Air Force Academy candidate group. After 1960, Academy candidates were no longer available for this purpose, but a method was devised for indirectly relating a new AFOQT form to a prior Academy candidate group. The specific group was made up of 5 105 candidates for the class of 1964. The indirect method has been described in general (Dailey, Shaycoft, & Orr, 1962), and in its specific application to the AFOQT (Miller & Valentine, 1964). Briefly, the method consists of equipercentile conversions from AFOQT Form G, which was administered to Academy candidates, through composites of tests from the Project TALENT battery to the new form of the AFOQT. The relationship between the TALENT composites and the new form is determined on samples of basic airmen stratified on the Armed Forces Qualification Test (AFQT) by deciles in the percentile range from 21 to 100. The composition of the TALENT composites is given in Table 5. The TALENT Academic composite is equivalent to the AFOQT Officer Quality composite with its biographical inventory omitted. Correlations of the TALENT composites with the corresponding AFOQT composites range from .80 to .88

Standardization of all five AFOQT composites should ideally make use of the same stratified basic airman sample. In practice, this requires an unreasonable amount of testing time per examinee. For this reason, three stratified samples were used. One sample was for standardization of

Table 5. **Composition of TALENT Composites Corresponding to AFOQT Form M Composites[a]**

TALENT Test	No. of Items	Weight in TALENT Composite				
		Pilot	Nav-Tech	Aca-demic	Verbal	Quanti-tative
102 Vocabulary (Information)	21				2	
103 Literature (Information)	24				2	
106 Mathematics (Information)	23		3	2	2	2
110 Aeronautics and Space (Information)	10	3		2	3	
111 Electricity and Electronics (Information)	20	1	2			
112 Mechanics (Information)	19	3				
250 Reading Comprehension	48			1	1	
270 Mechanical Reasoning	20	3	3			
281 Visualization in Two Dimensions	24	1				
282 Visualization in Three Dimensions	16	2	3			
312 Mathematics II: Introductory	24		3	2		2
333 Mathematics III: Advanced	14	2		3		3
Total	263					

[a]Data assembled from Dailey, Shaycoft, & Orr (1962, Table 9).

the Pilot composite, one for the Navigator-Technical composite, and one for the Officer Quality composite and its constituent Verbal and Quantitative composites. The three samples were compared, two at a time, in terms of their AFQT score distributions, and each pair was tested for significant differences by chi-square. The results are shown in Table 6. Differences in the samples are very small, and none are statistically significant.

Data obtained from monitoring the operational use of the AFOQT suggest that the test has unexpectedly become too difficult. In all programs combined, from 56 to 68 percent of the examinees scored at or above the 25th percentile on the three composites in Form L for which minimum qualifying scores are established. On the Verbal and Quantitative composites, where there are no minimum qualifying scores, the percentages are 62 and 45, respectively, in all programs other than AFROTC. In every case, the theoretically expected percentage is 75. The most severely affected composites are those containing the Quantitative Aptitude subtest.

Table 6. **Homogeneity of AFOQT Form M Normative Samples with Respect to AFQT Deciles**

Samples Compared	Chi-Square	df	P
Pilot and Navigator-Technical	0.172	7	>.99
Pilot and Officer Quality	0.023	7	>.99
Navigator-Technical and Officer Quality	0.079	7	>.99

Prior to AFOQT-64, it was considered desirable to correct AFOQT conversion tables to compensate for the self-selection process among Academy candidates which resulted in extremely high academic aptitude scores, especially in the quantitative domain. This correction is described elsewhere (Valentine & Creager, 1961). It involved referring score distributions to an earlier and less highly self-selected Academy candidate group, and it principally affected the composites containing the Quantitative Aptitude subtest. Beginning with AFOQT-64, the correction was dropped because it tended to make for a too easy test.

The recent operational data suggest that it is appropriate to reinstate this correction. This was accomplished readily because data are available relating both corrected and uncorrected AFOQT Form G distributions to the TALENT composites. An abridgment of the Form M conversion tables for examinees having less than two years of college is presented in Table 7, together with the tables as they would appear without the correction. The Pilot and Verbal composites are almost unaffected. The effect on the other composites should produce an increase in qualification rates without changing the AFOQT normative base in any fundamental way. Similar results can be expected at other educational levels where the AFOQT is used.

Table 7. **Conversion Tables for AFOQT Form M Examinees with Less than Two Years of College**

	Corrected					Uncorrected				
Percentile	Pilot	Nav-Tech	Male Officer Quality	Verbal	Quant	Pilot	Nav-Tech	Male Officer Quality	Verbal	Quant
90-95	136-204	109-220	118-200	48-60	35-60	135-204	115-220	120-200	49-60	41-60
80-85	123-135	97-108	111-117	42-47	31-34	125-134	104-114	114-119	45-48	38-40
70-75	114-122	91-96	107-110	39-41	28-30	115-124	94-103	110-113	41-44	34-37
60-65	106-113	85-90	103-106	37-38	26-27	107-114	87-93	106-109	38-40	32-33
50-55	98-105	80-84	99-102	35-36	24-25	99-106	82-86	103-105	36-37	30-31
40-45	92-97	75-79	95-98	33-34	22-23	92-98	78-81	100-102	34-35	28-29
30-35	85-91	69-74	90-94	30-32	20-21	85-91	72-77	94-99	32-33	26-27
20-25	77-84	63-68	84-89	26-29	18-19	77-84	65-71	88-93	28-31	24-25
10-15	68-76	57-62	78-83	22-25	14-17	66-76	55-64	80-87	23-27	20-23
01-05	0-67	0-56	0-77	0-21	0-13	0-65	0-54	0-79	0-22	0-19

VI. SCORE DISTRIBUTIONS

The stratified samples of basic airmen used in standardizing Form M are compared in Table 8 with similarly stratified samples of basic airmen, on which the relationships between TALENT and AFOQT composites were originally determined. The comparison is in terms of cumulative frequency distributions of TALENT composite scores. No correction is incorporated into this table, so it may be compared directly with corresponding tables for all AFOQT forms after Form G. The table indicates that the TALENT composites are somewhat less difficult for the Form M sample than for the original sample to which Form G was administered. This suggests the possibility that the recent increase in AFOQT disqualification rates may be related to changes in the officer applicant population in relation to the enlisted population.

Raw score means and standard deviations of Form M composites have been computed only for the stratified basic airman samples. These are reported in Table 9. Estimated means and standard deviations for a 12th grade male sample and the

Table 8. **Cumulative Percentage Distributions for TALENT Composites in Original Air Force TALENT Sample and AFOQT Form M Normative Samples**

AFOQT Percentile	TALENT Composite					
	Original AF TALENT Sample[a]			Form M Normative Samples[b]		
	Pilot	Nav-Tech	Academic	Pilot	Nav-Tech	Academic
95	0.8	0.6	0.1	0.4	0.3	0.1
90	1.6	0.9	0.4	1.2	0.5	0.2
85	2.5	1.3	0.5	1.9	0.7	0.7
80	3.3	1.6	0.6	3.0	1.3	1.1
75	4.4	2.0	0.9	4.3	2.5	2.1
70	6.1	2.7	1.3	4.8	2.6	2.5
65	7.4	3.2	1.7	6.5	3.3	3.0
60	9.2	3.8	2.2	8.1	4.2	3.6
55	10.4	4.5	2.7	10.5	5.4	5.0
50	11.6	5.3	3.4	12.7	6.3	5.5
45	13.3	6.2	3.8	16.0	7.5	6.3
40	15.5	7.3	4.5	19.0	9.1	7.8
35	17.7	8.3	5.4	21.4	12.8	9.8
30	21.2	10.2	6.6	26.0	14.1	11.9
25	25.1	12.4	8.2	30.9	17.8	15.1
20	29.3	15.2	10.5	35.3	22.3	18.8
15	34.8	18.6	13.6	42.2	27.9	23.6
10	42.5	23.5	18.4	50.8	35.6	30.2
05	56.6	34.4	29.5	64.7	49.4	44.5
01	100.0	100.0	100.0	100.0	100.0	100.0

[a]N = 2,489.

[b]Ns range from 935 to 937.

Table 9. **Raw Score Means and Standard Deviations of AFOQT Form M Composites for Five Groups**

AFOQT Composite	Stratified Basic Airmen[a]		12th Grade Males[b]		Examinees with Less than 2 Years College[c]		Examinees with 2 or More Years College[c]		Examinees who are College Graduates[c]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Pilot	69.8	25.0	68.6	29.0	96.5	22.7	100.0	24.2	103.0	25.2
Navigator-Technical	50.2	19.3	49.7	23.7	79.0	15.8	83.0	14.8	88.0	12.8
Officer Quality	74.0	15.2	72.7	18.8	98.0	11.5	104.5	10.0	110.5	7.0
Verbal	22.8	9.7	22.1	13.1	34.5	6.0	37.5	5.8	40.5	5.8
Quantitative	16.1	7.4	18.2	7.4	23.5	6.0	25.5	5.8	28.5	5.8

[a]Stratified on AFQT decile in range of 21st through 100th percentile. Ns vary from 935 to 937 for the various composites.

[b]Data estimated from unpublished tables by Dailey et al., 1962, based on 4 percent subsample of 12th grade males in original Project TALENT study. N = 2,403.

[c]Data estimated from AFOQT Form M conversion tables.

three educational levels in the operational population are also shown. These estimates are based on conversion tables and are somewhat inexact. However, with a few exceptions, they conform to the expectation that means will increase and standard deviations decrease in groups of increasing educational attainment. These data are meant to apply to unselected samples from the groups specified in the table.

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